The Ohio State University, College of Pharmacy, Division of Pharmacology

Pills, Potions, and Poisons: A High School Science Enrichment Program

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Introduction

It has become increasingly common knowledge that U.S. students have fallen behind in math and science compared with their peers in other developed countries. As a result, students lose interest at an early age and fail to pursue STEM-related careers. Scientists are active pursuers of knowledge—they immerse their minds and hands in the very problems they are solving. In order to retain students and encourage them to pursue STEM-related careers, we must teach science through an active, hands-on approach where students apply their scientific knowledge to solve real-world problems.

The interdisciplinary nature of pharmacology facilitates this approach—students must integrate and apply scientific knowledge from multiple disciplines to solve problems related to personal health and disease. Because drugs and disease pique student's interest, we decided that teaching science through pharmacology would provide an engaging platform for high school students to learn basic scientific concepts and increase interest in STEM related majors and careers. We created and implemented a week-long science enrichment and career exploration program for high school students titled, "Pills, Potions, and Poisons (PPP)."

- PPP provides students with an overview of pharmacology and its relationship to health, disease, and society.
- Students learn through a variety of approaches including lecture, discussion, debate, games, laboratory visits, and hands-on experiments.
- Students explore a variety of biomedical careers through research laboratory visits, hospital pharmacy visits, and discussions with student (undergraduate, graduate, and PharmD) teaching assistants (TAs) and faculty.

Outcomes from the PPP program include significant gains in participants' science knowledge as well as motivation and confidence toward science careers.

Table 1. Pills, Potions, and Poisons science content[1]

Day of Week	Daily Topic Focus	Biology Content	Chemistry Content	Other
Monday	Drug Action and Drug Targets	anatomy, cell structure, receptors, transporters, enzymes, DNA	chemical bonds, drug-target binding	physiology, pathophysiology, agonist v. antagonist drugs
Tuesday	Getting Drugs In, Around, and Out of the Body	membrane transport, circulatory system, diffusion, cell types	acid/base chemistry, enzymes, solubility, polarity, ionization	medical ethics
Wednesday	Dose Response and Drug Factors	Anatomy	molarity calculations, enzymes	physiology, dose-response relationships, drug-drug interactions
Thursday	Drug Abuse and Addiction	addiction biology, DNA	neurochemistry	genetics, medical ethics
Friday	Drug Discovery and Development	bacteria life cycle, plant biology	enzymes, polarity	viruses, antibiotic resistance, genetics

In the PPP program, students learn, integrate, and apply basic biology and chemistry concepts to more complex problems in human anatomy, physiology, and neurobiology through a variety of hands-on and minds-on activities and team-based approaches.

Overview and Outcomes

The PPP program emphasizes:

Communication & Teamwork skills

Hands-on Experiments

Career Exploration

Figure 1. The PPP Program Structure[1]

This flowchart gives a general overview of the structure of each day of the PPP program. Students learn through a variety of activities including experiments, simulation, discussion, debate, and games.

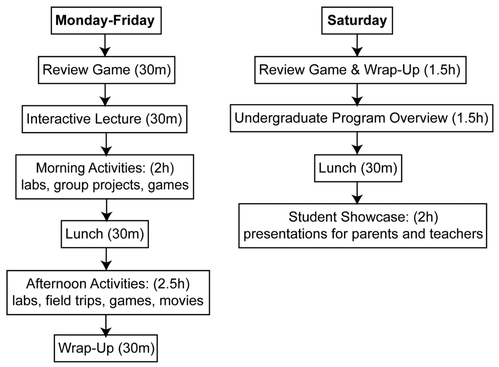
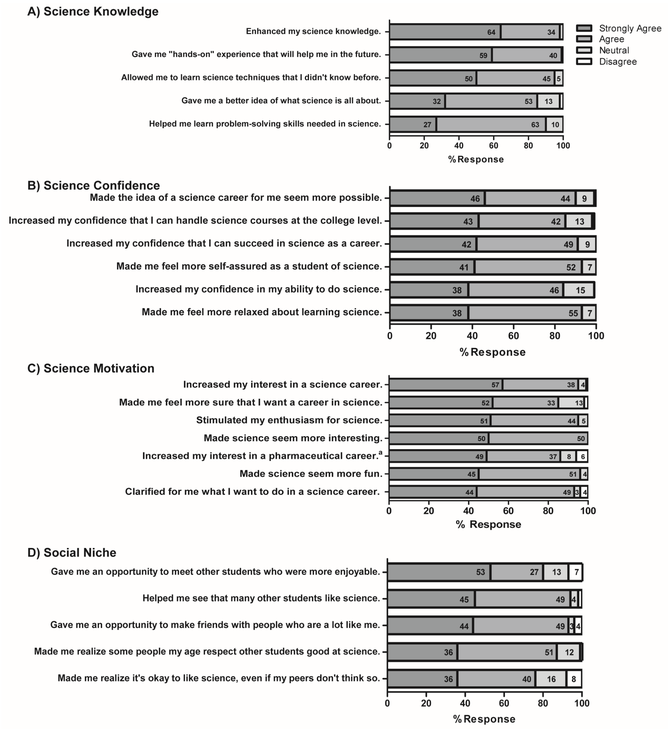
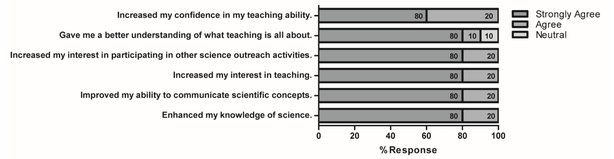


Figure 2. The PPP program positively impacts attitudes toward science in high school student participants.[1]



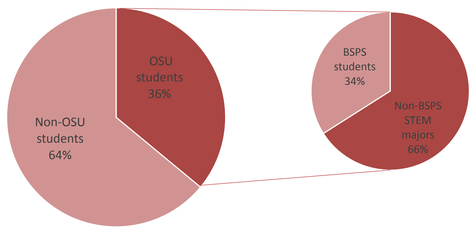
Career Impact

Figure 3. The PPP program also benefits student TAs.[1]



The student TAs indicated that the PPP teaching experience positively impacted their future career goals.

Figure 4. The PPP program fosters continued interest in STEM-related careers.[1]



During the program offerings from 2009 – 2016, 36% of PPP participants have since enrolled at OSU, with 34% of those students matriculating into the College of Pharmacy's Pharmaceutical Sciences undergraduate program (BSPS) specifically.

Future Goals

- Partner with local organizations or companies in an effort to:
  - Provide scholarships to select participants that cover program costs (current program fee is $175/participant).
  - Increase access to participants living outside the central Columbus area (e.g. provide scholarships for on-campus housing).
  - Expand off-site field trips to include community pharmacies, local pharmaceutical companies, etc.

Interested in seeing how you could get involved? Please contact Dr. Katie Summers at summers.266@osu.edu for more information.

Citation

1. Downing MN, Rooney KE, Turner AN, Kwiek N. The Impact of a Short-Term Pharmacology Enrichment Program on Knowledge and Science Attitudes in Precollege Students. Inov Pharm. 2016;7(2): Article 3. http://pubs.lib.umn.edu/innovations/vol7/iss2/3